SITE INVESTIGATION
PROPOSED RESIDENCE
MOANALUA, OAHU, HAWAII
FOR MR. AND MRS. WILLIAM AKI

DAMES & MOORE
JOB NO. 8669-001-11

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July 19, 1976

Mr. and Mrs. William Aki
2233 Anapanapa Street
Pearl City, Hawaii 96782

Dear Mr. and Mrs. Aki:

Site Investigation
Proposed Residence
Moanalua, Oahu, Hawaii
For Mr. and Mrs. William Aki

INTRODUCTION

This report presents the results of our site investigation of a house lot (Tax Map Key No. 1-1-45-113) for a proposed one-family residence in Moanalua, Oahu, Hawaii. The general location of the site is shown on the Map of Area, Plate 1. Our scope of work was generally indicated in our proposal dated July 8, 1976. Per this proposal, our investigation has been limited to the lower portion of the lot, below the drainage ditch, in the area where the house is to be built.

PROJECT CONSIDERATIONS

It is understood that this investigation is the result of the requirement of the Building Department of the City and County of Honolulu. This requirement indicates that the site should be evaluated by a soils engineer particularly in light of a relatively recent slope failure involving a house a short distance downslope of the present lot.

Plans for the proposed residence prepared by Robert K. K. Pang have been reviewed by us. The proposed structure will be a split level house with the lower level constructed on a bench, which will be cut into the existing slope and the upper level will be supported a few feet below the existing grade. The faces of the cut for the lower level will be supported by retaining walls.

SITE DESCRIPTION

The site is located on the north side of Ala Lani Street in Moanalua Valley, Oahu, adjacent to the ridge formed by Red Hill. The topography of the site and site layout is indicated on the Plot Plan, Plate 2. Slopes in the area of the proposed house range from 16 degrees at the downslope house line to roughly 30 degrees at the upslope house line.

The lot is covered with halekoa trees from three to five feet in height except for a grassy area which extends from elevation +290 up to the drainage ditch, on the east half of the lot. The halekoa on this site is generally growing upright and does not exhibit the characteristic downslope lean which usually indicates that soil creep is taking place.

The subsurface conditions on the site were investigated by the excavation of three test pits. Test pit locations are shown on Plate 2. Test Pits 1 and 2, performed under the technical supervision of one of our geologists, disclosed very hard, red-brown silt with numerous large unweathered basalt boulders up to two feet in largest dimension. This material is non-expansive and appears to be a residual soil derived from weathered-in-place basalt rock. Pocket penetrometer readings on this soil yielded pressures consistently greater than 4.5 kips per square foot. Test Pit 1 was excavated by a backhoe and reached a depth of 5.5 feet before further progress was prevented because of the large boulders. It is estimated that the bedrock surface here gradually grades from boulders with silt matrix into continuous rock. The bedrock surface can be approximated in Test Pit 1 at a depth of about 6 feet (Elevation -281 feet). Test Pit 2, which was excavated by hand, was terminated at 2.5 feet due to boulders.

Test Pit 3, excavated (by backhoe) adjacent to the existing road disclosed a somewhat different soil, characterized as a slightly expansive dark brown silt with boulders. This soil is possibly fill material placed during the construction of the roadway. It does not appear to extend laterally into the lot more than two or three feet north of the lower (south) property line.

Detailed logs of the soils encountered during this investigation are presented on the Log of Test Pits, Plate 3. Soils were classified according to the Unified Soil Classification System shown on Plate 4. Soil Samples were obtained by means of a Dames & Moore Type D Sampler (Exhibit 1) which was hand-driven with a 40-pound hammer (12-inch drop).

Additional information on site conditions was obtained by observation of an existing outcrop located about 20 feet west of this lot. This outcrop extends from roughly elevation +276 to +284 and discloses similar conditions to those found in Test Pits 1 and 2. Large boulders (to three feet in diameter) were observed within very hard silt matrix.

LABORATORY TESTING

Laboratory testing was performed on the samples obtained to determine their expansion characteristics.

EXPANSION TESTS

The expansion of a laterally confined sample against a surcharge load is measured after saturation until expansion ceases. The expansion of the sample is expressed in percent of the original sample height.

Test Pit No.	Depth (ft)	Surcharge (psf)	Expansion (%)
1	5.0	200	-0.9
3	2.5	200	1.5

DISCUSSIONS AND RECOMMENDATIONS

GENERAL

The site appears to be generally suited to the proposed construction of a single-family residence. The soil conditions are good and do not display the characteristics which are normally found in problem areas where the soils may subject to mass movement. In addition, it appears that the south portion of the proposed house will be supported on rock.

EXCAVATION

It is anticipated that the proposed cut for this project will encounter basalt rock where excavation extends more than approximtely six feet below the existing grade. Rock may exist at a more shallow depth toward the upper part of the lot.

Consistent with our previous work in this area, we recommend that excavations in rock be constructed on slopes not steeper than ½ (horizontal) to 1 (vertical) (½:1). Slopes excavated in soil should be constructed to stand at not steeper than 2 (horizontal) to 1 (vertical) (2:1).

Depending on the depth at which rock is encountered, some redesign of the upper slopes may be necessary to adjust to these recommendations. Following excavation, all soil covered slopes should be planted as soon as possible to minimize erosion.

FOUNDATIONS

Where basalt bedrock is encountered during excavation, the foundations for the proposed house and retaining wall should be placed on this rock utilizing an allowable bearing pressure of 5000 pounds per square foot. For footings bearing on the residual soil, an allowable bearing pressure of 2500 psf may be used. All footings should have a minimum width of 18 inches.

RETAINING WALL

For the proposed retaining wall, which is planned to be about 10 feet high, we recommend a design active lateral pressure of 200 pounds per square foot uniform load. This wall should be backfilled with granular, free-draining material nd weep hopes should be provided every 10 feet to prevent moisture build-up behind the wall.

SLABS-ON-GRADE

For slabs-on-grade, a 6-inch capillary break layer of 3B fine rock should be provided immediately beneath the slab. This layer is to discourage the accumulation of water beneath the slab. Furthermore, in moisture sensitive areas, an impermeable membrane should be placed between the crushed rock layer and the slab. This membrane can be sandwiched between one inch sand layers to minimize puncture during construction.

This report has been prepared for the owners, Mr. & Mrs. William Aki, for design purposes in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report.

We have appreciated the opportunity to perform this work for you, and if there are any questions concerning this presentation, please contact us.

Yours very truly,

DAMES & MOORE

Howard Schirmer, Jr.

HAS:CCF:imi
(Four copies submitted)

Attachments:

Plate 1	Map of Area
Plate 2	Plot Plan
Plate 3	Log of Test Pits
Plate 4	Unified Soil Classification System
Exhibit 1	Soil Sampler Type D

GENERAL LOCATION OF SITE AS SHOWN ON PLOT PLAN

MAP OF AREA

SCALE 1:24000

1 MILE

7000 FEET

1 KILOMETER

REFERENCE:
U.S.G.S. Topographic Map
Oahu, Hawaii
Dated 1958

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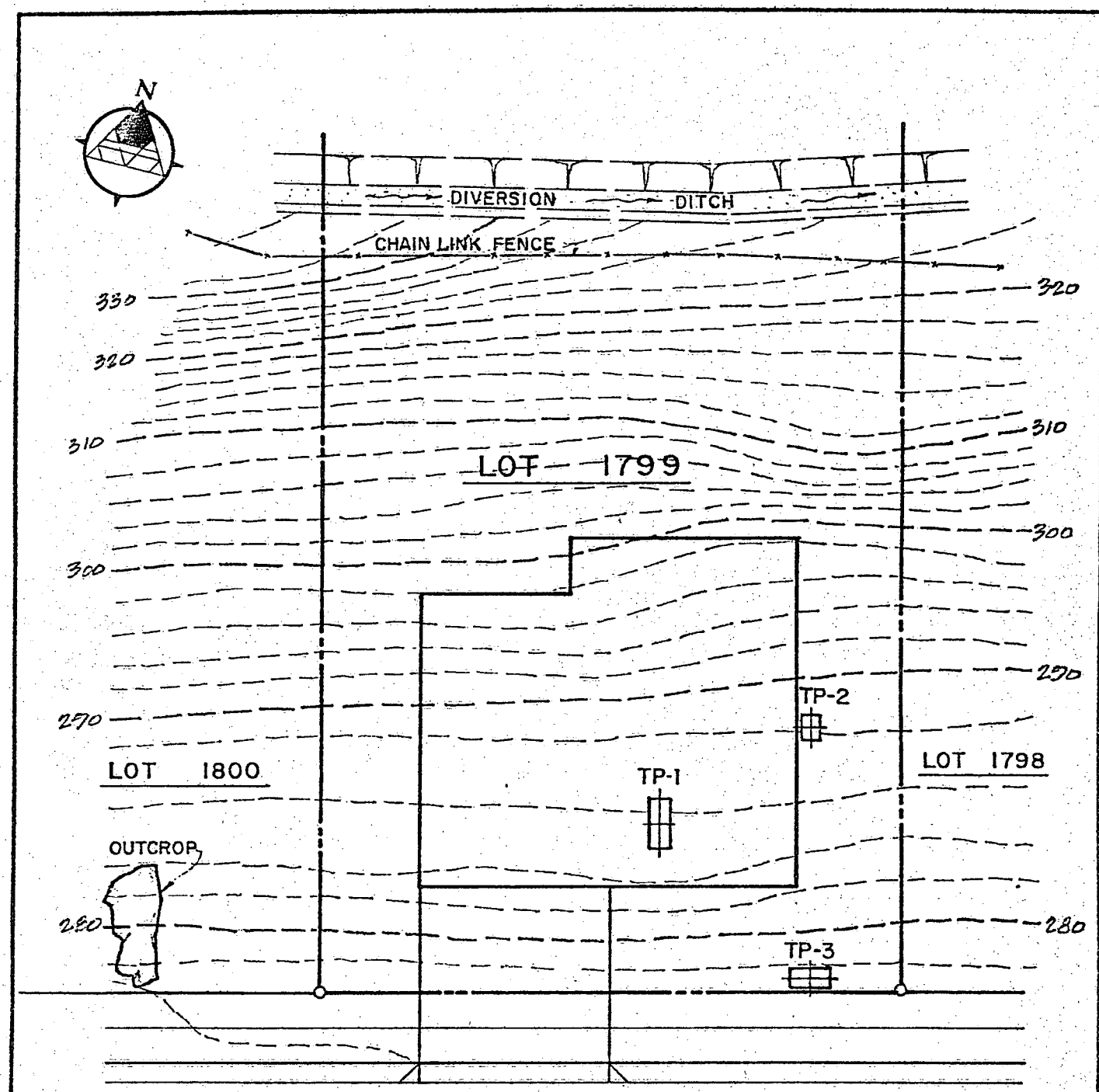
PLATE 1



ALA LANI STREET

LEGEND

DAMES & MOORE TEST PIT

REFERENCE

TOPOGRAPHIC SURVEY MAP, LOT 1799
PREPARED BY SAM O. HIROTA, INC.
DATED JULY 13, 1976
TMK: 1-1-45:113

PLOT PLAN

100 50 0 50 100 200

SCALE IN FEET

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REVISIONS BY DATE

FILE

CHECKED BY DATE NAS

REVISIONS BY DATE

FILE

CHECKED BY

TEST PIT 1

Surface Elevation 287 Feet
MSL Datum

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler *	Samples	Depth in Feet	Graph Symbol	Letter Symbol	Description
18	70	15/6"	▨			MH-GM	Red-brown mottled gravelly silt, hard, with unweathered basalt boulders (residual soil)
		30/3"	⊠	5			grades to large boulders silt matrix, very hard

Test pit completed at 5.5 feet on 7-9-76
No water encountered

TEST PIT 2

Surface Elevation 288 Feet
MSL Datum

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler *	Samples	Depth in Feet	Graph Symbol	Letter Symbol	Description
		15/2"	⊠			MH-GM	Red, brown and gray gravelly silt with boulders (to 2' diameter), very hard (residual soil)

Test pit completed at 2.5 feet on 7-9-76
No water encountered

TEST PIT 3

Surface Elevation 276 Feet
MSL Datum

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler *	Samples	Depth in Feet	Graph Symbol	Letter Symbol	Description
25	71	20/4"	⊠			MH-GM	Dark brown mottled silt with gravel, very hard (fill?)
		20/6"	▨				grades with large boulders
		5/2"	⊠				

Test pit completed at 3.9 feet on 7-9-76
No water encountered

LOG OF TEST PITS

Notes:
* Hammer Weight = 40 pounds dropping 12"
▨ - Depth at which undisturbed sample was taken
⊠ - Depth at which disturbed sample was taken

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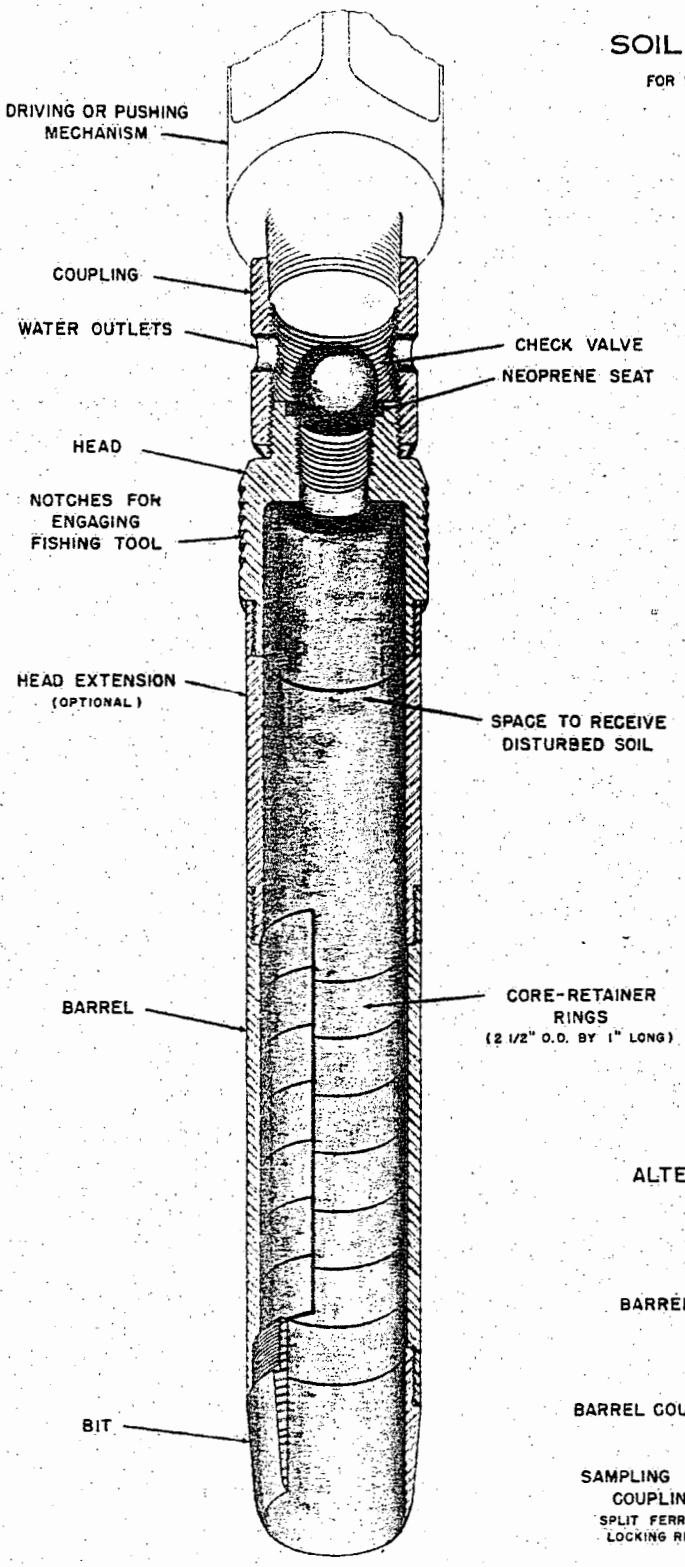
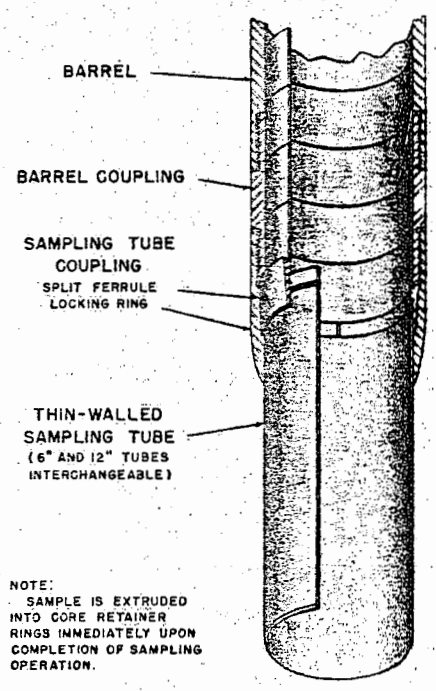
PLATE 3

SOIL SAMPLER TYPE D

FOR SOILS EASY TO RETAIN IN SAMPLER



ALTERNATE ATTACHMENTS



NOTE:
SAMPLE IS EXTRUDED INTO CORE RETAINER RINGS IMMEDIATELY UPON COMPLETION OF SAMPLING OPERATION.

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EXHIBIT 1

(2-62)

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50 % OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE, FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50 % OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS — LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

NOTES:

1. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS.
2. WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF COHESIONLESS SOILS.

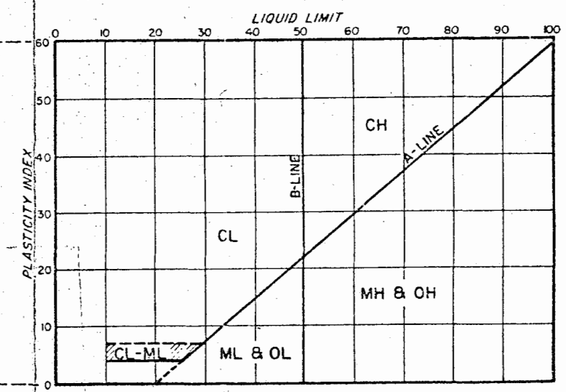
COHESIVE SOILS	(APPROXIMATE SHEARING STRENGTH IN KSF)	COHESIONLESS SOILS	
VERY SOFT	LESS THAN .25	VERY LOOSE	THESE ARE USUALLY BASED ON AN EXAMINATION OF SOIL SAMPLES, PENETRATION RESISTANCE, AND SOIL DENSITY DATA.
SOFT	0.25 TO 0.5	LOOSE	
MEDIUM STIFF	0.5 TO 1.0	MEDIUM DENSE	
STIFF	1.0 TO 2.0	DENSE	
VERY STIFF	2.0 TO 4.0	VERY DENSE	
HARD	GREATER THAN 4.0		

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE*	MILLIMETERS	SIEVE SIZE*
SAND				
FINE	.074	#200*	0.42	#40*
MEDIUM	0.42	#40*	2.00	#10 *
COARSE	2.00	#10*	4.76	#4 *
GRAVEL				
FINE	4.76	#4 *	19.1	3/4"*
COARSE	19.1	3/4"*	76.2	3"*
COBBLES	76.2	3" *	304.8	12"*
BOULDERS	304.8	12"*	914.4	36"

*U.S. STANDARD *CLEAR SQUARE OPENINGS

PLASTICITY CHART



SAMPLES

- ☒ INDICATES UNDISTURBED SAMPLE
- ☒ INDICATES DISTURBED SAMPLE
- ☐ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- I INDICATES LENGTH OF CORING RUN

NOTE:
DEFINITIONS OF ANY ADDITIONAL DATA REGARDING SAMPLES ARE ENTERED ON THE FIRST LOG ON WHICH THE DATA APPEAR.

UNIFIED SOIL CLASSIFICATION SYSTEM

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PLATE 4